On an unusual Form of the Genus *Hemipholis*, Agass.

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(Plate VI.)

Amongst some dredgings from off the Agulhas Bank, south-west of the Cape of Good Hope, given to me by Dr. Wallich, I found several small Ophiurans. One of them struck me at once as presenting a very unusual combination of structures. The disk was symmetrically plated above, the arms were almost moniliform and had a few spines projecting from their sides, and the oral apparatus, elongated downwards, had its teeth in close apposition. A non-plated skin covered the interbrachial spaces; and no proper mouth-papillæ or tooth-papillæ were visible. These characteristics were so suggestive, that a careful examination of the form was necessary.

The specimen is a dry one and brilliantly white in colour. The disk is slightly pentangular in outline, and it is tumid above, where it is covered with a few large and regularly placed plates united at their edges.

There is a large central rosette occupying the greater part of the upper surface, and the central plate (a regular pentagon) is the largest. The other five which surround it are slightly smaller, and are united to it and to their neighbours by straight edges. Their external margin is curved, and they are rather unequal in size.

The radial shields are large, and some are separated, orally, by a minute triangular scale, which is in contact with one of the plates of the rosette; but where this scale does not exist, the radial shields are united together, and are in broad contact with the outer rosette-shields.

Their distal margin is broad, sharp, and slightly incurved where it arches over the upper surface of the arm. In the interradial spaces there are only two plates, which are large, one being in contact with the rosette and the other extending to the margin of the disk, where it ends in a sharp edge.

Underneath, the disk is more pentagonal in outline than when seen from above, and the margin is sharp and distinct. There are no plates in the interbrachial spaces; but there is a skin there, which is covered with a very delicate cellular coat.

The mouth-shields are small and triangular in outline; they are about as long as broad, are pointed orally, and are outwardly curved distally. Their position is very oblique; and their free surface passes downwards and inwards, so that the proximal end is on a lower plane than the broad distal curve. The sides are slightly incurved.

The side mouth-shields are very small and narrow; they do not meet orally, and they are as long as about one half of the side of the mouth-shield. Each supports a long and slender spinule, which projects downwards and slightly outwards, and is situated at the end of the inner third of the shield and aborally to a large tentacular opening. The oral ends of the jaws are close together, and are on a lower plane than the side mouth-shields; hence the jaws and the lowest true teeth project downwards. Their mutual contact forms a small pentagonal area with curved edges, closed by the lower teeth; and this is at the end of a process which projects downwards in consequence of the downward curving of the jaws.

There are thus no true mouth-papillæ, and tooth-papillæ are absent. The first tentacle-spine is not visible high up at the side of the jaw, and the spaces between the jaw-angles are nearly covered with a delicate skin. The lowest tooth of each jaw is in close contact with its neighbours; they are all on a level plane and completely close the oral passage. The teeth are triangular in outline. The spaces between the jaw-angles are mere slits, and no tentacle passes through them. The first tentacle is in the place occupied in other forms by the second tentacle, and it is large and in relation to the spine on the side mouth-shield. This spine, according to ordinary terminology, would be a mouth-papilla, so that each angle has two of these.

The arms, five in number, are unequal in size; and there are only two joints within the disk, but they are broad, and encroach upon the interbrachial spaces.

The first lower arm-plate is very small, and is faintly covered with the extension of cellular skin; and its shape is rather that of a hatchet. The distal edge is the broadest, and is curved distally, whilst the inner or oral edge is narrow. The sides are greatly incurved for the tentacular opening. The second plate, small and about as broad as long, is broadest aborally, where it is boldly curved. It is narrowest orally, where it is in relation to a space covered with skin between the side arm-plates. The sides are re-enteringly curved, and much of their space corresponds to the large tentacular opening. The third, fourth, and fifth lower arm-plates correspond in shape with the second; but towards the tip of the arm the plates become smaller and longer than broad and more constricted.

The upper arm-plates are slightly broader than long, and are convex from side to side; they are boldly curved distally, and their sides are outwardly curved. The first is hidden, and the second is partly hidden proximally, by the meeting of the side arm-plates. Towards the tip they become longer than broad and rather angular distally. The side arm-plates form much of the arm, and meet, both above and beneath the arm, along the median line, and they form a long cylindrical tip to the arm. They are narrowed just beyond the upper arm-plates; they then swell out and have convex sides. They are long, down the arm, and three long, sharp, slender spines are on each near the disk; but further out two are seen on either side. The spines project outwards from the arm, and are as long as the side arm-plate, or longer. The lowest spine is the smallest; and it is so placed on the lower aspect of the side arm-plate as to occupy the position of a tentacle-scale; it projects downwards and sideways. Beneath the arm the side arm-plates are large, and their length of median junction is greater than above. The first pair are large, are united orally, and in the midst, but at the distal end there is a space which has already been mentioned, and it elongates towards the tip of the arm. There are no proper tentacle-scales, and the tentacles are long and stout.

The colour of the specimen, which is dry, is white, and the upper arm-plates are beautifully cellular.

The length of the specimen is about $\frac{1}{8}$ inch.

Locality. Agulhas Bank. Collected by Dr. Wallich.

Remarks.—Although the specimen to which this description alludes is young, it is not immature, except in regard to the ends of the arms. Its large plating on the disk, the naked under-disk, the downward projection of the oral apparatus, the absence of true mouth- and tooth-papillæ, the comparative occlusion of the interangular spaces, and the close fitting of the triangular-shaped teeth, one and all, belong or relate to an Ophiurid which has all its normal and most of the adult structures.

The zoological position of the form is not without doubt; for the classification of the Ophiuroidea is at present full of anomalies, and the admission of unusual forms into any group is beset with difficulties. The naked interbrachial spaces and the paucity of oral accessories (admitting, for the sake of argument, the spines on the side mouth-shields to be "mouth-papillæ"), and the general shape and anatomy of the arms, permit of the association of the species with *Hemipholis,* Agass. But the great plates on the upper part of the disk are not invariable in the genus, and the long curved and downward projecting jaws would be abnormal to it. This genus, however, is the most convenient, and therefore I place the species therein, subject to the concurrence or opposition of a classificatory dogma which insists upon the primary value of characters relating to the very variable dermal structures.

But the zoological position is the least important part of the environment of this remarkable species. The nature of the so-called dental or "chewing" apparatus is full of interest; and its consideration suggests the necessity of employing new terms and of deciding the physiology of the oral structures.

The mouth-papillæ of Ophiurans, whatever may be their number, breadth, or length, should arise from the sides of the jaw-angles; and there are instances where they may originate at the junction of the jaw and the side mouth-shield. The origin of a mouth-papilla from the side mouth-shield alone is often seen, and it is always in relation to the tentacle-opening close by. Another mouth-papilla is said to exist high up in the jaw-angle, and it is close to the first tentacular opening. It is clear, to my mind, that the so-called mouth-papillæ arising from the side mouth-shields, and also those coming from the side of the jaw close to the first tentacular opening, are more or less modified tentacle-scales, and should be called tentacle-scales or spines. They may be absolutely like tentacle-scales or sharp spines. Tentacle-scale is therefore their proper name. This will restrict the term mouth-papilla to its proper limit, on the lower sides of the angles and below the jaw-plate. They partly cover over the lower outlet of the jaw-angle, whose cavity communicates with the true oral passage. They are dermal structures. In the species now under consideration the derm from the sides of the jaw-angles is not in the form of denticulations, spinules, or angular processes, but is a lamina, so closely approximated to that of the neighbouring angle-side that a mere slit exists, so perfect is the closure. The use of this dermal prolongation, this continuous analogue of the mouth-papilla, is the same (but in a greater degree) as that of the ordinary mouth-papillæ at the sides of the jaw-angles. All are filterers, and prevent large pieces of substance from entering the digestive cavity. So far as the mouth-papillæ of many genera are concerned, their shape and position contraindicate the possibility of any individual movement of the jaw-angles towards or from the oral axis.

It is evident that the specimen under examination has the true teeth horizontally placed, although the position of the jaws, and necessarily of the jaw-plates, is oblique, and also that these triangular teeth are so closely in apposition that no substance of a visible size can pass up into the stomach.

In the Ophiuroidea, as a whole, there is a gradation between this almost occluded condition and a wide separation of the points of the true teeth after death. The true teeth are attached at right angles to the long axis of the jaw-plate, which is fixed externally to the jaw, and they project into the canal leading to the stomach according to their size. Sometimes pointed bluntly, they are at others broad, and are either convex or concave at their free internal surface. They are capable of passive up-and-down flap-like movement to a slight degree; but the statement that they are fixed on to the jaw-plate by muscles I have not been able to verify. Certainly no muscular fibres like those in the arms are to be found; and the substance which really connects teeth and jaw-plates is connective tissue. The microscopic character of the so-called teeth in the majority of instances indicates that the granules of calcareous matter are arranged more or less in a cellular fashion. There is nothing like a worn surface to be seen on any of the teeth, which in some genera are finely ornamented with spinules; and, indeed, usually they have an axial space between their free internal edges.

There may be a dermal growth below the end of the jaw-angle; and this may be of all shapes, from the nodular to that of a true tooth. It is a mouth-papilla according to systematic writers, and probably correctly so. Often sufficiently difficult of distinction from the lowest true tooth, this papilla has the same physiological significance.

In several genera, *Ophiothrix* being the best example, a number of dermal spinules of different lengths are arranged on the inner side of the lower end of the jaw-plate, in the position of the lowest true teeth; they are the dental tooth-papillæ. Usually their free surface slants downwards and outwards and away from the axial line. They clearly cannot be approximated to chew.

The use of the teeth and other structures on the end of the jaw-angle and of the tooth-papillæ is to filter the water which is constantly passing into the stomach, to keep out particles which might be too large and also living intruders. A movement of the jaw-angles towards each other and the central axis of the mouth, sufficient to bring the teeth in forcible apposition, does not seem possible. But in some species there is a slight enlargement possible of the so-called mouth; and the series of teeth of each jaw-plate may be more or less distant from their fellows. Contraction, however, beyond a certain limit would cause crushing of the delicately spinuled teeth of such forms as *Ophioscolex*. The enlargement of the mouth and consequent separation of the jaws is common in those genera the species of which can move the arms upwards; but this appears usually to be a convulsive action preceding death, a *rigor mortis* determines the persistence of the condition, and *post mortem* rigidity permanently widens the space between the jaw-angles in many forms. Nevertheless there are species which have the circle of side mouth-shields discontinuous, whose arms are capable of a slight upward and aboral movement, and whose mouth-canal can be widened and narrowed during life. Mr. W. Percy Sladen, F.L.S., is now investigating the disk and arm attachments and insertions of some hitherto unnoticed muscular slips which appear to explain this movement.

I have named this species after its discoverer, *Hemipholis Wallichii*.

EXPLANATION OF PLATE VI.

Fig. 1. *Hemipholis Wallichii*, Duncan, about nat. size.
2. The under part of the disk and arms, magnified.
3. The upper part of the disk and arms, magnified.
4. Diagrammatic section from above downwards of the disk, showing the projecting spine on the side mouth-shield.
5. Arm-spine, magnified.

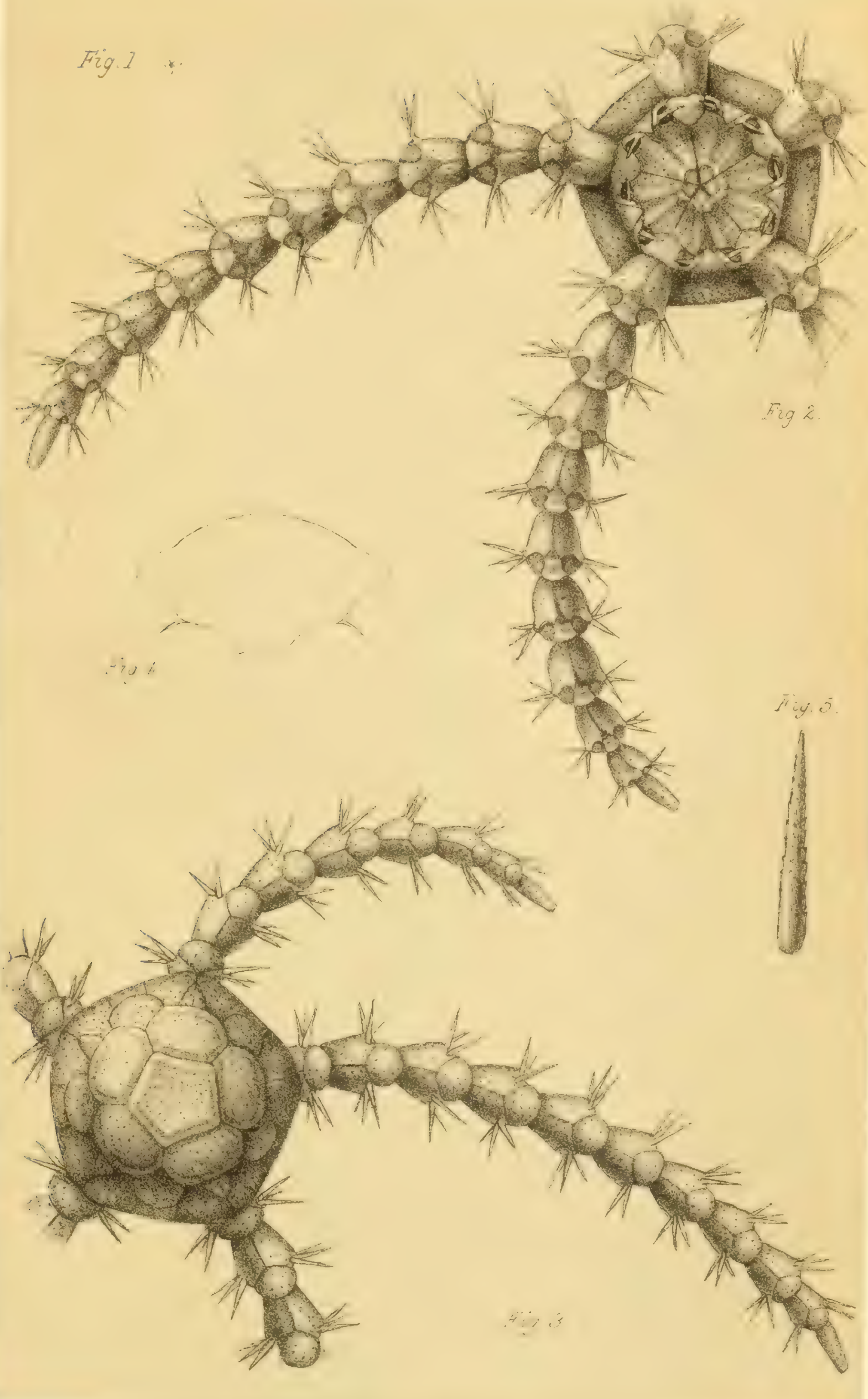

Fig. 1

Fig. 2.

Fig. 4

Fig. 5.

Fig. 3

Berjeau lith.

Hanhart imp.

HEMIPHOLIS WALLICHII, *Duncan*